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Award Number: DAMD17-00-1-0254

TITLE: Evaluation of Response to Induction Therapy in Breast
Cancer with Phosphorus-31 Magnetic Resonance

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REPORT DATE: August 2001

TYPE OF REPORT: Annual

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for Public Release;
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REPORT DOCUMENTATION PAGEForm Approved
OMB No. 074-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE August 2001	3. REPORT TYPE AND DATES COVERED Annual (10 Jul 00 - 9 Jul 01)	
4. TITLE AND SUBTITLE Evaluation of Response to Induction Therapy in Breast Cancer with Phosphorus-31 Magnetic Resonance			5. FUNDING NUMBERS DAMD17-00-1-0254	
6. AUTHOR(S) Leoncio Garrido, Ph.D.				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Massachusetts General Hospital Boston, Massachusetts 02114-2554 E-Mail: garrido@nmr.mgh.harvard.edu			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Medical Research and Materiel Command Fort Detrick, Maryland 21702-5012			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
<div style="font-size: 2em; font-weight: bold;">20011130 046</div>				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; Distribution Unlimited			12b. DISTRIBUTION CODE	
13. Abstract (Maximum 200 Words) (abstract should contain no proprietary or confidential information) The objective of the proposed research is to develop 1H-decoupled 31P magnetic resonance spectroscopy (MRS) techniques for measuring non-invasively the response of breast cancer to induction or preoperative chemotherapy. We hypothesize that the quantitative assessment of the effectiveness of a treatment using 31P MRS will be clinically feasible at 3.0T. To validate our approach, we propose first, to perform measurements using appropriate standards and, second, a pilot study including women with breast cancer undergoing induction chemotherapy. During the first year of funding, a prototype double tuned proton/31-phosphorus transmit-receive coil has been built. The coil has been tested at 3.0T (proton frequency: 123.23 MHz; 31-phosphorus: 49.89 MHz) by using standards containing compounds of interest (phosphorylethanolamine, inorganic phosphate and 5-adenosine triphosphate).				
14. Subject Terms (keywords previously assigned to proposal abstract or terms which apply to this award) Diagnosis, magnetic resonance spectroscopy, induction chemotherapy, prognostic markers, phosphorus metabolism			15. NUMBER OF PAGES 5	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited	

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INTRODUCTION

Advances in the understanding of the biology of breast cancer are leading to the identification of novel therapeutic targets, the development of new cytotoxic agents and strategies for treatment of this disease. The identification of a marker of tumor response to a specific chemotherapeutic agent will make possible to customize an effective treatment for each patient. Phosphorus-31 (31P) MRS can provide information non-invasively on alterations in tumor metabolism caused by chemotherapy in women with breast cancer. Thus, the objective of the proposed research is to develop 1H-decoupled 31P magnetic resonance spectroscopy (MRS) techniques for measuring non-invasively the response of breast cancer to induction or preoperative chemotherapy. To validate our approach, we propose first, to perform measurements using appropriate standards and, second, a pilot study including women with breast cancer undergoing induction chemotherapy.

BODY

During the first year of funding, the approved Statement of Work included in Task 1, the construction and test of rf coils for proton imaging of the breast and detection of 31P at 3.0T, the optimization of the protocols and, in Task 2, the initiation of the *in vivo* studies. To date, progress in the proposed research has been slowed by a delay in the delivery of the 3.0T system for thoracic imaging, initially scheduled for October 2000. The system has now been tested at the manufacturer's site (Siemens AG, Erlangen, Germany) and manufacturer's estimate for the delivery date is August 21, 2001. Despite the technical problems, we have accomplished part of the objectives outlined in Task 1. A prototype double tuned proton/31-phosphorus transmit-receive coil has been built. The coil was tested on a 3.0T Allegra (Siemens AG) by using samples with known concentrations of phosphorus metabolites of interest for the proposed research. Specifically, a standard with phosphate buffered solution, pH = 7 (100 cc, 50 mM, potassium monobasic phosphate + sodium hydroxide), having 20 mM of phosphorylethanolamine (PE) and 20 mM of 5-adenosine triphosphate (ATP) was prepared.

Proton imaging protocols currently applied to clinical breast imaging at lower fields were used to acquire images at 3.0T (proton frequency: 123.23 MHz). These protocols included proton density, T2-weighted and fast gradient echo imaging. The typical signal-to-noise ratio, SNR, obtained with the standard solution mentioned above was 60.

Figure 1 shows a 31-phosphorus spectrum of the standard solution acquired at a frequency of 49.89 MHz by using a one pulse sequence. The total acquisition time was 17 minutes. The resonances of PE (+3 ppm), inorganic phosphate and γ -ATP (+1 ppm), α -ATP (-9.5 ppm) and β -ATP (-21.5 ppm) are observed. The chemical shifts were externally referred to that of 85% phosphoric acid. Optimization of the hardware and protocols will be performed immediately after installation of the 3.0T whole body scanner at the end of this month. It is anticipated that we will be able to perform *in vivo* 31-phosphorus measurements by the end of 2001.

KEY RESEARCH ACCOMPLISHMENTS

- Construction of double tuned proton/31-phosphorus coil
- Test of coil with standard solutions

REPORTABLE OUTCOMES

No reportable outcomes from this research have resulted yet.

CONCLUSIONS

In summary, we have built and tested the necessary hardware to perform the proposed 31 -phosphorus measurements. This will allow us to continue with the task outlined in the approved Statement of Work for the next funding period.

REFERENCES

n/a

APPENDICES

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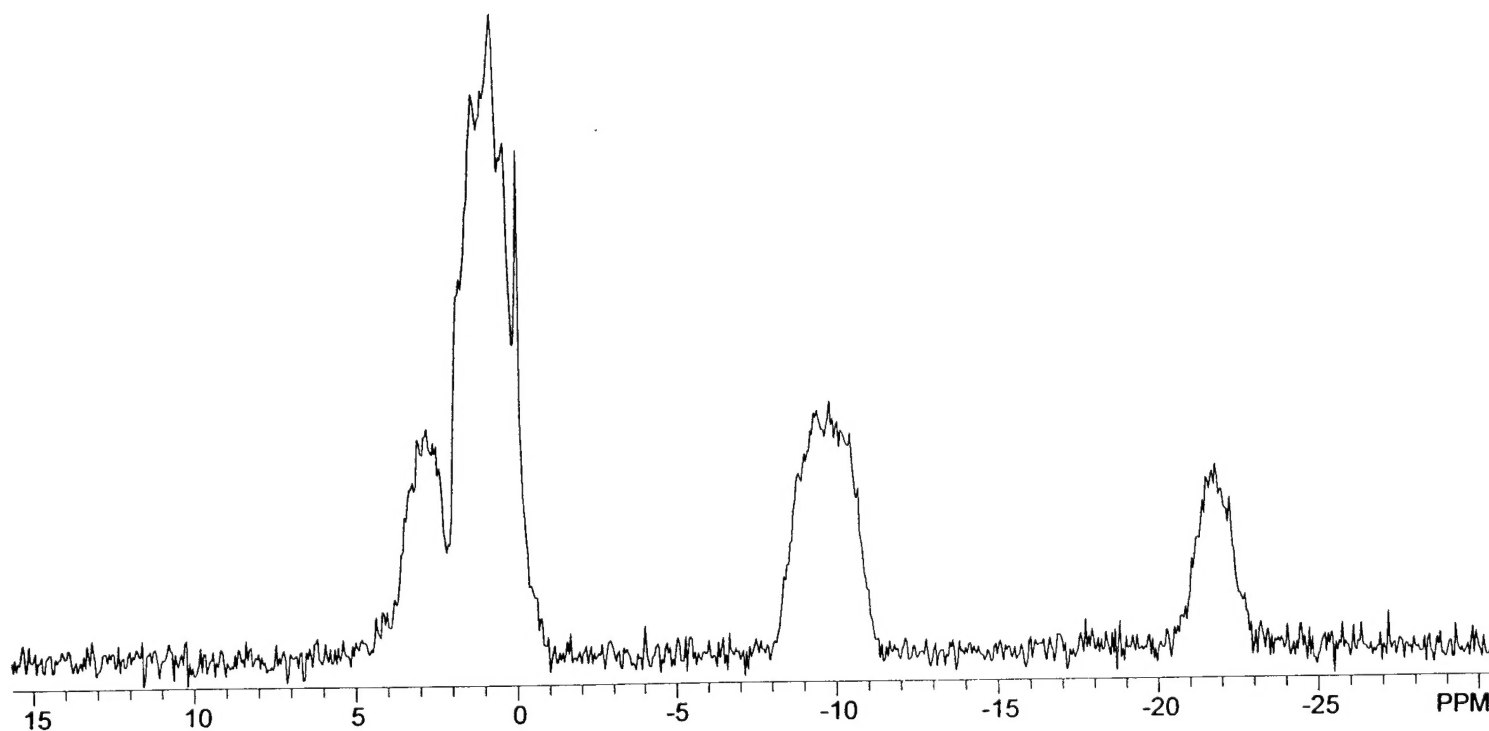


Figure 1. 31 -Phosphorus spectrum of a standard solution containing phosphorylethanolamine (PE) (chemical shift at +3 ppm); 20 mM, 5-adenosine triphosphate (ATP) 20 mM (chemical shifts at +1, -9.5 and -21.5 ppm) and inorganic phosphate 50 mM (chemical shift at +1 ppm) acquired at 3.0T (31 P frequency: 49.89 MHz).